Office of National Marine Sanctuaries/National Centers for Coastal Ocean Science Long-term Agreement (ONMS/NCCOS LTA)

2004 Annual Liaison Report on Existing and Potential ONMS/NCCOS Collaborative Studies at the Stellwagen Bank National Marine Sanctuary (SBNMS)

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December 2004

1. Introduction

A partnership between NCCOS and the ONMS was initiated in 1999 to provide a stronger and more effective science base for managing NOAA's National Marine Sanctuaries. Under this partnership, NCCOS's role is to work with ONMS to conduct research aimed at addressing sanctuary management needs and to help apply this and related information in the development and implementation of effective management plans. The following four research priorities are to be the focus of this effort over the next several years: (1) baseline characterizations of sanctuary resources; (2) monitoring for potential environmental changes; (3) "anticipatory science" to develop and test new technologies for monitoring the health of these systems; and (4) special studies to address specific critical issues that may develop. Research liaison positions have been established within NCCOS to help facilitate this process for each of NOAA's National Marine Sanctuaries. NCCOS liaison activities at the Stellwagen Bank National Marine Sanctuary (SBMNS) began in spring 2003. Each year, as part of the partnership process, the NCCOS liaison and SBNMS research coordinator will be working together to assess current research gaps and needs relative to the sanctuary's management goals, and to make recommendations for how the partnership can be leveraged to help address these needs. The purpose of the following report is to provide such an assessment for the FY04 annual reporting period.

2. SBNMS Overview

Stellwagen Bank is located in the extreme southwestern Gulf of Maine, within Massachusetts Bay (Figure 1). The Bank's southern end is situated approximately six miles north-northwest of Provincetown, Massachusetts. In accordance with Title III of the Marine Protection, Research and Sanctuaries Act of 1972, as amended, 16 U.S.C. 1431 et seq., a Final Environmental Impact Statement and Management Plan proposed implementation of the Congressionally designated Stellwagen Bank National Marine Sanctuary (P. L. 102-587, §2202) to facilitate the long-term protection and management of the resources and qualities of the Stellwagen Bank system.

The sanctuary boundary surrounds the entire Stellwagen Bank and includes approximately 638 square nautical miles (842 square miles). The glacially-deposited Bank feature measures approximately 16.30 nautical miles (18.75 miles; 30.17 km) in length, and 5.43 nautical miles (6.25 miles; 10.01 km) in width, at its widest point. Two distinct peak productivity periods produce a complex system of overlapping mid-water and benthic habitats within the sanctuary study area. Commercially important fisheries include extensive benthic, invertebrate, and pelagic species. The system provides important feeding and nursery grounds for large and small cetacean species, several of which are endangered. Diverse bird species forage at the Bank, some in direct association with feeding cetaceans and fishing vessels.

Traditionally, the principal human activity dependent on the Bank's resources has been commercial fishing, and this tradition continues. Recently, whale-watching has also become an important commercial activity. To a lesser degree, sportfishing also generates significant economic revenues. Additional human activities involving the Bank system include recreational

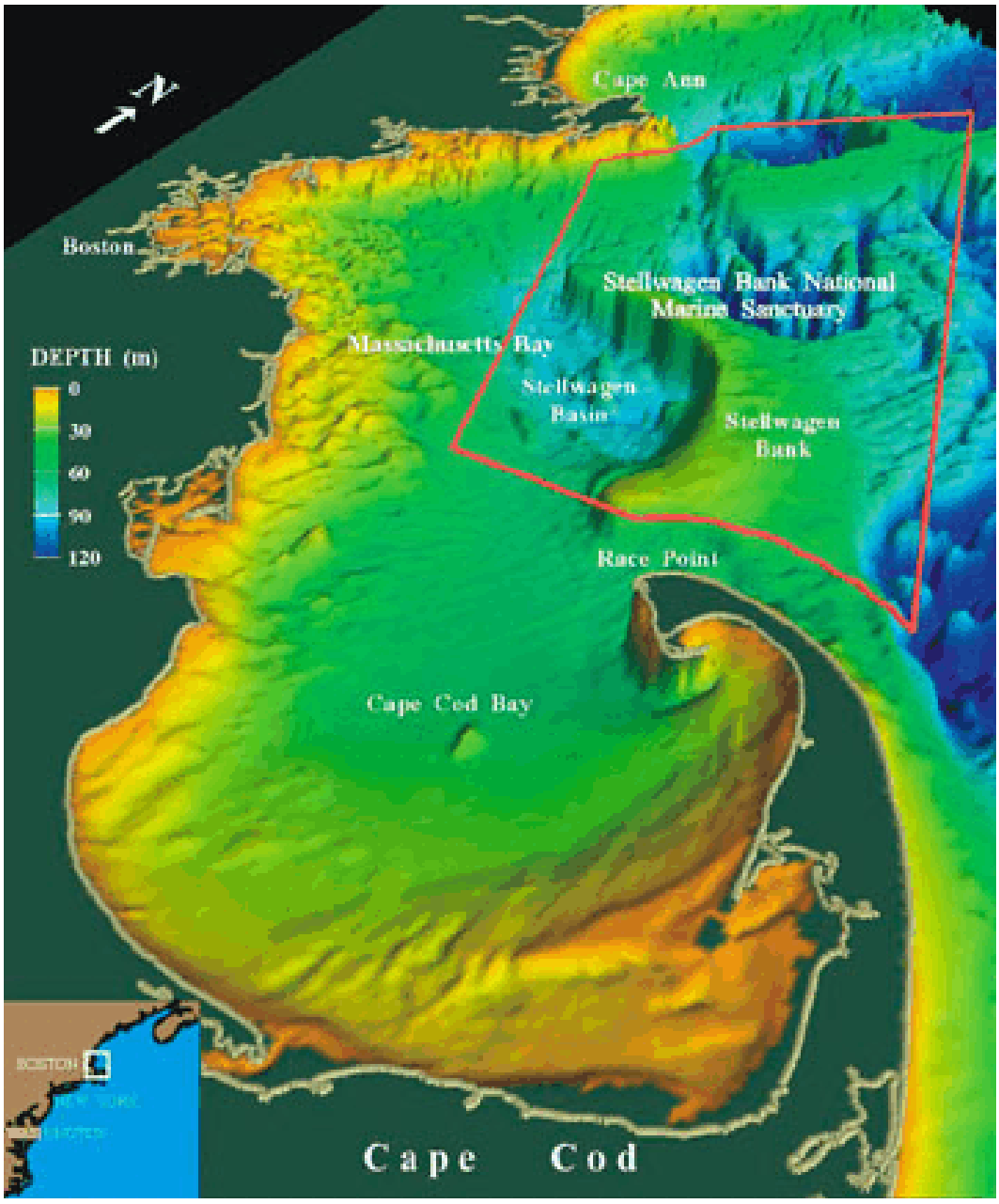

Figure 1. Stellwagen Bank National Marine Sanctuary. (USGS).

fishing, research, commercial shipping, and dredged materials disposal. In addition to these activities, possible sand/gravel mining, development of offshore artificial fixed platforms, and mariculture operations could affect Stellwagen Bank resources and qualities in the future

Management actions for SBNMS are considered within the context of three categories of program objectives: resource protection, research, and interpretation/education. Resource protection will involve including the enforcement of regulations. Research will include baseline, monitoring, and predictive studies to provide information needed to address management issues. Interpretation/education programs will focus on improving public awareness and understanding of sanctuary resources, and the need to protect them.

The following activities are regulated within SBNMS:

1. Discharging or depositing of materials or substances, (either within or from outside the sanctuary)

2. Developing offshore industrial materials

3. Construction, placement, or abandonment of any substance or material on, or any alteration of, the seabed

4. Removing or damaging historical resources

5. Taking marine mammals, marine reptiles, and seabirds (except as permitted by the Marine Mammal Protection Act, the Endangered Species Act, and the Migratory Bird Treaty Act)

6. Transferring any petroleum-based product from vessel-to-vessel ("lightering")

7. Possessing any historical resource, or any marine mammal, marine reptile, or seabird taken in violation of the Marine Mammal Protection Act, the Endangered Species Actor the Migratory Bird Treaty Act

8. Interfering, obstructing, delaying or preventing any investigation, search, seizure or disposition of seized property in connection with enforcement of the Act

Several activities also are identified as "subject to regulation", but will not be regulated now.

1. offshore hydrocarbon activities

2. mariculture activities

3. vessel operation

3. Science Capabilities of NCCOS

Detailed descriptions of the National Centers for Coastal Ocean Science (NCCOS) can be obtained through the NCCOS website and associated links at <http://www.nccos.noaa.gov>. Highlights of this information (extracted from the website) are presented here as a brief overview of NCCOS programs and capabilities that can be leveraged through the NCCOS-NMS partnership to help the SBNMS fill data gaps and future management needs.

NCCOS, with headquarters in Silver Spring MD, was formed as a part of the National Ocean Service in March 1999 as a means of consolidating its coastal research capabilities. Five research centers exist at present under NCCOS: the Center for Sponsored Coastal Ocean Research (CSCOR) in Silver Spring, MD; the Center for Coastal Monitoring and Assessment (CCMA) also in Silver Spring, MD; the Center for Coastal Fisheries and Habitat Research (CCFHR) in Beaufort, NC; the Center for Coastal Environmental Health and Biomolecular Research (CCEHBR) with facilities both in Charleston, SC and Oxford, MD; and the Hollings Marine Laboratory (HML) in Charleston, SC. Collectively across these centers, NCCOS offers a broad range of complementary capabilities in disciplines such as marine ecology and biology, fishery ecology and management, marine pathology, microbiology, molecular and cellular biology, genetics, biochemistry, ecotoxicology, environmental chemistry, marine forensics, remote sensing, biogeography, ecological statistics, GIS analysis, environmental risk analysis, coastal-resource management, and information technology.

NCCOS conducts and sponsors a variety of monitoring, assessment, research, and technical-assistance projects to support the coastal stewardship role of NOS and to help NOAA achieve its related national strategic goal of sustaining healthy coastal ecosystems. The combined capabilities listed above are available to address a broad range of environmental issues pertinent to this mission. Key goals are to:

> Deliver high-quality science in a timely and consistent manner using strong, productive partnerships; Develop and maintain relevant research, long-term data collection and analyses, and forecasting capabilities to support people who manage and use coastal resources; Build capacity in the private, local, and state sectors by transferring technology and by providing technical assistance and knowledge; and Conduct anticipatory science needed to manage potential impacts of multiple stresses on coastal ecosystems.

In addressing these goals, NCCOS currently is focusing its science on five major categories of ecosystem stress:

I. Climate change,
II. Extreme natural events,
III. Pollution,
IV. Invasive species, and
V. Land and resource use

Understanding how these complex issues affect the quality and quantity of coastal habitats, and the diversity, abundances, and integrity of component living resources, is vital for the effective management of our Nation's coastal ecosystems. NCCOS is attempting to develop this knowledge by focusing its efforts currently on four ecosystem categories: coral reefs, estuaries, National Estuarine Research Reserves, and National Marine Sanctuaries. The latter commitment to working within sanctuaries has been formalized through the ongoing ONMS/NCCOS partnership.

NCCOS also provides a capability to perform Integrated Assessments (IAs) as a strategy for addressing coastal ecosystem effects with respect to any particular combination of the above stressor and ecosystem categories. Integrated assessments consist of the following steps: (1) documenting status and trends of ecosystem and/or cultural resource conditions, (2) relating such trends to their environmental or economic causes and consequences, (3) predicting outcomes of alternative management actions, and (4) providing guidance for implementing the alternatives. A successful IA is one that is responsive to policy-relevant questions, includes peer review and public participation, is broadly integrative and synthetic, is based on high-quality existing information, and is predictive. The IA approach provides a science-based framework for determining the source and scale of an existing environmental problem and evaluating various alternative management strategies.

Each NCCOS center provides a unique set of capabilities that could be utilized to help support sanctuary research and educational needs. These Centers and their corresponding programs include:

Center for Coastal Monitoring and Assessment (CCMA)
The center is located in Silver Spring, Maryland. CCMA monitors, surveys, and assesses coastal environmental quality, habitats, and resource distribution. CCMA also is home of the National Status and Trends Program (NS&T), which conducts long-term contaminant monitoring at more than 350 estuarine and coastal sites around the country. Information from the Center's monitoring and assessment studies are synthesized and evaluated to determine the impacts of contaminant exposure and changes in coastal habitats on the distribution and abundance of living marine resources. CCMA's major program areas are in biogeographic characterization, bioeffects monitoring, and remote sensing. For further information contact the CCMA website at <http://ccmaserver.nos.noaa.gov>.

Biogeography Program http://biogeo.nos.noaa.gov
Activities focus on developing products, applications and processes for defining and interpreting the relationships of species distributions and their environments.

- Benthic habitat mapping
- Aerial photography interpretation
- GIS habitat suitability modeling
- Compilations of species distribution abundance and life history information
- Strategic assessment data atlases
- GIS resource assessment and spatial modeling

Bio-effects Program http://nsandt.noaa.gov/index_bioeffect.htr
Activities focus on assessments of sediment toxicity surveys, evaluation and application of bio-markers, development of effect-based numerical toxicological guidelines, and formulation of coastal ecosystem condition indices.

- Bioassays for acute toxicity, impaired fertilization and development, and physiological stress for invertebrates and vertebrates
- Bio-markers for sub-oraganismic response to contaminant exposure
- An Integrated Bio-effect Assessment for Boston Harbor and Massachusetts Bay (adjacent to Stellwagen Bank NMS) is currently available in pdf format at the following link : http://nsandt.noaa.gov/publications/download_pdf/techmemo96.pdf

Remote Sensing Development Program http://ccmaserver.nos.noaa.gov/RemoteSensing.htr
Activities focus on development and application of new remote sensing techniques for assessment of estuarine and coastal environmental issues with and emphasis on satellite-borne sensors and integration with field observations.

- Algorithm development for SeaWIFs ocean color in the coastal zone
- Remote detection of plankton blooms
- Rapid assessment of trends in coastal habitat cover
- Development of methods fro merging satellite and aircraft-borne remote data for determination of coastal water quality pattern and trends

CCMA publications: http://ccmaserver.nos.noaa.gov/pubs.html

Center for Coastal Environmental Health and Biomolecular Research (CCEHBR)
The center has laboratories both in Charleston, South Carolina and Oxford, Maryland. CCEHBR provides scientific information required to resolve important issues related to the health of coastal ecosystems, environmental quality, and related public health impacts. Chemical, biomolecular, microbiological, histological, toxicological, and ecological research tools are used to characterize the health of coastal ecosystems, including living resources and their associated habitats, and to assess and predict the causes and consequences of various human and natural stressors on the integrity of these resources. Major research areas include: marine biotoxins and harmful algal blooms, marine ecotoxicology, marine pathology, marine biotechnology and genetics, coral health, invasive species management, health of marine protected species (sea turtles and marine mammals), marine forensics, environmental risk analysis, and coastal ecology. For further information contact the CCEHBR website at <http://www.chbr.noaa.gov>.
Activities focus on determining the health status of marine species in coastal ecosystems using genetics, population biology, and health and disease modeling. Health assessments encompass processes at the molecular, cellular, organ and organism level.

Living Marine Resources Branch http://www.chbr.noaa.gov/LivingMarineResources.html
Marine Mammal and Protected Resources Program

- Photo identification
- Genetic identification

- Telemetry
- Pathology
- Life history
- Contaminant burdens

Marine Biotechnology Program
- Genetic identification of species and stocks
- Sex determination and paternity
- Bio-indicators for environmental stress
- Pathobiology for the study of disease dynamics

Marine Ecotoxicology Branch http://www.chbr.noaa.gov/MarineEcotoxicology.html
Activities focus on establishing links between land use and contaminants in coastal environments. Interdisciplinary research targets chemical and bacterial contaminants associated with anthropogenic inputs from agriculture, urbanization, dredging and industry and resulting toxicological and ecological impacts on coastal ecosystems.

Toxicology and Physiology Program
- Bio-markers of sub-lethal stress in estuarine ecosystems

Environmental Microbiology Program
- Methods to identify sources of bacterial contaminants

Chemical Contaminants Program
- Analysis of field samples for chemical contaminants
- Laboratory toxicology

Ecotoxicology Program
- Toxicology of anthropogenic and natural contaminants in coastal zone
- Identify links between land use and contaminants in marine systems

Ecotoxicological Modeling Program
- Mathematical and visual models of perturbations to coastal systems
- Modeling pharmacological response to xenobiotics in sentinel organisms

Toxicity Testing Program
- Toxicity assays with metabolism, growth, development, reproduction and mortality as specified endpoints
- Trophic transfer of contaminants
- Specific and non-specific bio-markers

Mesocosm Testing Program
- Simulated salt-marsh system
- Application of environmental bio-markers
- Integration of single-species toxicity testing with field testing and monitoring

- Dredge spoil and bio-remediation assessments

Marine Forensics Branch http://www.chbr.noaa.gov/MarineForensics.html
Activities focus on law enforcement support, mortality investigations and marine lipid chemistry. Integrative strategies using morphology, biochemisrty, chemistry, and genetics help to resolve forensic issues for conservation and management of marine resources.

- Analysis of proteins, lipids, nucleic acids and contaminants
- Monoclonal antibody and electrophoretic techniques
- Trophic transfer of dietary fatty acids

Risk Analysis and Information Branch http://www.chbr.noaa.gov/branches/raim/index.html
Activities focus on scientific studies in partnership with others to improve utility and access to scientific information within the coastal science community.

- Synthesize, analyze and disseminate information on coastal processes
- Design, implement and maintain computing systems
- Develop and administer enterprise-wide databases
- Develop enhanced predictive capabilities and risk management options

CCEHBR publications: http://mrl.cofc.edu/pubs.html

Hollings Marine Laboratory (HML)
The center, named after Senator E. Fritz Hollings, is located in Charleston, South Carolina. HML, which opened recently in 2002, is a newly established multi-institutional, multi-disciplinary laboratory providing science and biotechnology applications to sustain, protect, and restore coastal ecosystems, with emphasis on linkages between the environment and human health. Major research areas include: environmental/analytical chemistry, marine genomics, molecular biology and physiology, contemporary use of pesticides, ecotoxicology, proteomics, and aquaculture production and disease. HML is co-occupied by several partnering institutions including NCCOS, South Carolina Department of Natural Resources, University of Charleston, National Institute of Standards and Technology (NIST), and the Medical University of South Carolina. It is governed by an Executive Board, a Science Board, and several operational committees, under the leadership of a NOAA/NCCOS laboratory director. For further information contact the HML website at <http://www.nccos.noaa.gov/about/hml.html>.
Activities focus on multi-disciplinary science and biotechnology applications to sustain, protect and restore coastal ecosystems.

- Environmental/analytical chemistry
- Environmental biology/response evaluation
- Cryogenic tissue storage
- Molecular biology and physiology
- Aquatic organism production facilities

Center for Sponsored Coastal Ocean Science (CSCOR)
The center is located in Silver Spring, Maryland. CSCOR operates the Coastal Ocean Program (COP), which is a federal-academic partnership providing predictive capabilities for managing coastal ecosystems. COP supports research in three areas: coastal fisheries ecosystems, cumulative coastal impacts, and harmful algal blooms/eutrophication. For further information contact the CSCOR website at <http://www.cop.noaa.gov>. Activities focus on providing direct financial assistance in the form of discretionary grants and cooperative agreements for coastal ecosystem science efforts to improve predictions of fish stocks, conservation and management of living marine resources, predictions of coastal ocean pollution to help correct and prevent ecosystem degradation, development of ocean science technology, and prediction of coastal hazards. General grant terms and conditions can be found at
http://www.cop.noaa.gov/Grants/FY03GenFRN.htm

- Support for Coastal Ecosystem Oceanography
- Support for Cumulative Coastal Hazards
- Support for Harmful Algal Blooms

CSCOR publications: http://www.cop.noaa.gov/pubs.htm

Center for Coastal Fisheries and Habitat Research (CCFHR)
The center is located in Beaufort, North Carolina. CCFHR consists of the following teams conducting a combination of laboratory and field research: Fisheries Oceanography and Ecology; Plankton Ecology and Physiology; Applied Spatial Ecology and Habitat Characterizations; Fish Ecology, Habitat Restoration, and Contaminants; and Coastal and Estuarine Ecosystem Restoration Research. Key areas of research include: coastal habitat utilization and restoration, fish ecology, chemical and physiological processes, ecology and oceanography of harmful algal blooms, population dynamics of reef and coastal fish species, and marine protected species (sea turtle and marine mammal). For further information contact the CCFHR website at <http://shrimp.ccfhrb.noaa.gov>.Activities focus on phytoplankton ecology and physiology, fish biology, fisheries oceanography, marine ecology, marine chemistry and habitat restoration in coastal and oceanic ecosystems.

Fisheries Oceanography and Ecology Team
Activities focus on the study of biological and physical processes, acting in a variety of habitats and across a range of spatial and temporal scales, that influence the distribution and abundance of marine fishes. Activities focus on the biology and ecology of larval, juvenile and adult fishes and invertebrate nekton in coastal and offshore systems.

- Vertical distribution of fish eggs and larvae
- Larval transport
- Water mass tracking
- Langmuir circulation

- Larval growth and survival
- Larval fish taxonomy
- Scientific illustration of early life stages
- Otolith microstructure image analysis
- Otolith chemistry
- Larval rearing capability
- Modeling (e.g. bio-physical, bio-energetic, artificial neural networks)
- Distribution and abundance
- Age, growth and mortality
- Spawning habits
- Design and monitoring of estuarine restoration

Plankton Ecology and Physiology Team
Activities focus on the ecology and oceanography of phytoplankton blooms and plankton physiology.

- Physical aspects of bloom dynamics and transport
- Remote sensing methods for detection of algal blooms
- Trophic transfer of algal toxins
- Algal species identification using traditional taxonomy and molecular probes
- Algal trace metal chemistry
- Algal growth and nutrient limitation
- Zooplankton biology and ecology

Applied Spatial Ecology and Habitat Characterization Team
Activities focus on spatially-explicit habitat characterization integrated with structural, functional, and biological attributes of coastal systems.

- SCUBA and mixed-gas diving
- Underwater towed sensing system (e.g. SONAR, video)
- ROV's
- Satellite and air-borne remote sensing
- GIS applications
- Spatial analysis (e.g. semi-variograms, fractals)
- Habitat classification protocols
- Habitat restoration planning
- Ecological forecasting of habitat change
- Seagrass ecology

Coastal and Estuarine Ecosystem Restoration Research Team
Activities focus on marine community ecology and the disturbance response and recovery dynamics of marshes, seagrasses, reefs, and soft bottom habitats.

- Benthic habitat restoration techniques
- Functional analysis of marsh and seagrass restoration
- Recovery modeling
- Food web analysis using stable isotopes
- SCUBA and mixed-gas diving
- GIS applications
- Marine community ecology

Forecasting and Related Research Team
Activities focus on research to facilitate ecological forecasts useful to coastal managers and the public. Environmental data are evaluated to establish ecological patterns in coastal ecosystems and their vulnerability to change. Laboratory and field (physical, chemical, & physiological) experiments are conducted to establish the causal basis of observed patterns. From observation and experiments development of models, forecasts, and evaluation tests of potential impacts of stressors on coastal ecosystems.

- predicting change in coastal habitats in response to changes in land and resource use
- forecast changes in contaminant exposure and bioaccumulation of contaminants
- predict the impacts on larval and juvenile fishes of nutrient additions and hypoxia
- predictive models that forecast the propagation potential of invasive species

CCFHR publications: http://shrimp.ccfhrb.noaa.gov/admin/labpubs.html

4. Stellwagen Bank NMS Management Needs

Management needs for Stellwagen Bank NMS are focused on the goals and objectives outlined below and in the 1993 Sanctuary Management Plan located at http://stellwagen.nos.noaa.gov/management/sections/managementPlan/1993PlanHome.html . Although sanctuary goals and objectives are listed discretely, their effects overlap. For instance, research and interpretation/education efforts contribute both to resource protection, and to enhancement of public use of the sanctuary.

Resource Protection

The highest priority management goal is protection of the marine environment and resources of the Stellwagen Bank NMS.

- Establish cooperative agreements and other mechanisms for coordination among all the agencies participating in sanctuary management
- Develop an effective and coordinated program for the enforcement of sanctuary regulations
- Promote public awareness of and voluntary user compliance with regulations through an interpretation/education program stressing resource sensitivity and wise use

- Reduce threats to sanctuary resources posed by major emergencies through contingency and emergency response planning.

Research and Monitoring

Sanctuary research will build upon existing data to improve overall understanding of the Stellwagen Bank environment and resources, and to identify and resolve specific management issues.

- Establish a framework and procedures for administering research projects to ensure that they are responsive to management concerns, and that research results contribute to improved management of the sanctuary
- Gather necessary baseline data on the physical, chemical, and biological characteristics of the sanctuary
- Gather necessary baseline data on cultural and historical resources of the sanctuary
- Monitor and assess environmental changes as they occur
- Identify the range of effects on the sanctuary environment resulting from changes in human activities
- Incorporate research results into the interpretation/education program in a format useful for resource users and the general public
- Encourage information exchange among all agencies and organizations conducting management-related research in the sanctuary, to promote informed management

Outreach

The interpretation/education program is directed to improving public awareness and understanding of the significance of the sanctuary and the need to protect its resources.

- Provide the public with information on the sanctuary, and its goals and objectives, with an emphasis on the need to use its resources wisely to ensure their long-term viability
- Enhance and broaden support for the sanctuary and sanctuary management by offering programs suited to visitors with a range of diverse interests
- Provide for public involvement by encouraging feedback on the effectiveness of interpretation/education programs
- Collaborate with other organizations to provide interpretation/education services, including extension and outreach programs and other volunteer projects, that explain the purposes of the sanctuary and the National Marine Sanctuary Program

Visitor Use

The sanctuary's overall goal for visitor management is to encourage commercial and recreational uses of the sanctuary, compatible with resource protection.

- Provide relevant information about sanctuary resources and sanctuary uses policies

- Collaborate with public and private organizations in promoting compatible uses of the sanctuary by exchanging information concerning its commercial and recreational potential
- Monitor and assess the levels of sanctuary use to identify and control potential degradation of resources and minimize potential user conflicts

Management Plan Review Update: 1998-2002
http://stellwagen.nos.noaa.gov/management/sections/managementplanreview/manPlanUpdateHome.html The public identified several high-profile topics as important matters for sanctuary management during scoping meetings and associated comment period of 1998/99. The issues and concerns that follow relate to these topics. They are representative of the comments received at that time and lend perspective to continued scoping, which is scheduled for Summer/Fall 2002.

Each concern is followed by possible actions suggested through sanctuary staff analysis. The actions are indicative of the kinds of management strategies the site could develop to address the issues and concerns presented. Consider them only as examples for the eventual development of actual management strategies.

Alteration of Seafloor Habitat and Ecosystem Protection

The alteration of seafloor habitat in the sanctuary was an issue of particular concern. Comments focused specifically on the growing evidence that fishing effort with certain gear types (mostly bottom trawls and dredges) is having significant and measurable impacts on benthic communities. Some argued that these activities might be dramatically changing community compositions and affecting ecosystem processes.

Repeated interest was expressed in the use of marine zoning a means to limit or exclude particular activities (such as fishing with mobile gear). Part of a zoning plan might involve no-take marine reserves, areas that exclude fishing activity entirely, for a subset of each major seafloor habitat type. Opportunity exists to work cooperatively with the National Marine Fisheries Service and the New England Fishery Management Council in addressing this issue.

Other areas of concern focused on human impacts to living marine resources from such activities as ghost fishing (lost gear that continues to fish), fiber optic cable installation, ocean dumping, marine debris, off-shore mariculture and coastal run-off. Many argued for increased efforts to better understand sanctuary biodiversity and impacts of human activity, placing greater emphasis on ecosystem conservation. The need for monitoring ecosystem condition was expressed, as was boundary expansion to include more diverse habitat types.

Marine Mammal Protection

The need for increased protection of various marine mammals in the sanctuary was a large concern voiced by scoping participants. To provide better protection, the site needs more information about such things as how marine mammals use the sanctuary and how their sex, age, maternal lineage, calving history and distribution affect their populations. Habitat requirements, prey bases, interrelationships with other species, and impacts of humans on their behavior were noted as important to know. Within the larger issue of human impacts, three concerns stood out in particular.

The first concern focused on the role of vessels in the harassment, injury and mortality of marine mammals, particularly the "seen" whale around which vessels congregate. It was deemed appropriate that the sanctuary direct greater effort toward establishing programs to encourage responsible whale watching within its boundaries.

The second concern related to the "unseen" whale. This is a whale that surfaces unexpectedly in the path of a moving vessel or is subsurface, but at a depth at which it could be struck. It was pointed out that an increased number of ship strikes are occurring in areas where whales congregate near shipping lanes or where vessel speed among whale watch vessels and recreational boats could be a factor.

The third concern focused on marine mammal entanglements and the associated risk of mortality. Entanglements often involve fishing gear, derelict or otherwise. Of note, the appearance of an entangled animal in the sanctuary does not necessarily mean that the animal became entangled in the sanctuary. Marine mammals are wide ranging and may encounter gear elsewhere and drag it long distances.

General concerns raised included the impact of vessel noise and other human generated acoustics on marine mammals, a lack of coordination among various regional marine mammal protection agencies, inadequate guidelines for approach distances to whales, impacts from off-shore mariculture on marine mammals (e.g., risk of entanglement), and the potential northward extension of the sanctuary boundary to include additional marine mammal feeding areas on Jeffreys Ledge.

Condition of Water Quality

Public concerns over issues of water quality in the sanctuary were numerous. Many of these concerns were due in large part to the opening of the 9.5-mile long sewage and wastewater discharge pipe operated by the Massachusetts Water Resources Authority. A clearer understanding of the outfall's effects on the sanctuary ecosystem is needed, particularly any impacts it could have on the endangered right whale or other marine mammal species.

A second concern related to the dumping of graywater and head waste in the sanctuary. It was commented that the impact of individual and cumulative dumping events on sanctuary resources

could be harmful and significant in the case of endangered species, while the process of dumping was counter to the image of the sanctuary.

Further concern was raised over the lack of information on the bioaccumulation of toxins and contaminants in various sanctuary resources. Data on the levels of contaminants of living marine resources in the sanctuary are limited at best, and almost no information exists to address the effects of pathogens (bacteria, viruses and parasites). The sanctuary was urged to identify areas of potential or existing contaminant accumulation, evaluate potential pollutant contributions from various sources (e.g., outfall, disposal sites, atmospheric deposition), and determine the incidence level and impact of contaminants and pathogens on sanctuary resources.

Concern also was expressed over the potential impact of offshore mariculture operations on water quality. Currently, mariculture activities do not occur there, though the potential for off-shore work in the region has been discussed.

Finally, scoping participants argued that the sanctuary needs to be better prepared for a hazardous materials (HazMat) spill and be better educated on response. It is incumbent upon the sanctuary, to have a plan for cooperating with and supplementing the overarching HazMat plans of various other water quality authorities in the Massachusetts Bay area.

Lack of Public Awareness

Many concerns were directed to the sanctuary's limited visibility in the general public. Citizens suggest that efforts to increase name recognition and enhance public understanding of the sanctuary and its resources. Scoping participants also called for the sanctuary to serve as a conduit of information to user groups including researchers, fishermen, scientists and recreational boat owners, and to conduct naturalist training and certification.

Effective Enforcement

Many concerns were expressed regarding enforcement in the sanctuary. Several of those providing comments noted that compliance with laws and regulations was unlikely without an enforcement presence and that enforcement was therefore critical to effective protection of resources. The general sentiment was expressed that existing laws need to be better enforced. Other comments were directed at enforcement of voluntary guidelines associated with whale watching (which can only be encouraged, not legally enforced) and the need to strengthen regulations. Commenters stated that current sanctuary regulations alone are insufficient to protect sanctuary resources.

5. SBNMS Science Needs

Science needs required for effective management of SBNMS have been identified in several recent documents including:

State of the Sanctuary Report
http://stellwagen.nos.noaa.gov/management/sections/managementplanreview/stateReport/reportHome.html
1995 Sanctuary Site Report
http://stellwagen.nos.noaa.gov/about/sitereport/toc.html

ONMS Sanctuary Science: Evaluation of Status and Information Needs
http://sanctuaries.nos.noaa.gov/library/national/science_eval.pdf

Additional science needs, linked to management issues, will be identified following the completion of the revised Sanctuary Management Plan in 2003: Management Plan Review Update: 1998-2002
http://stellwagen.nos.noaa.gov/management/sections/managementplanreview/manPlanUpdateHome.html

Current science needs can be grouped into three primary categories:

Descriptive research

- Design and implement a spatially-referenced inventory of habitat types
- Regional marine mammal data set development and analysis
- Compile existing biological and ecological information of sanctuary biota
- Map distribution of biota by habitat
- Determine spatial and temporal distribution and level of fishing effort/harvest
- Compile tourism profile (location, activities, intensity of use)
- Map human user-group distribution by habitat

Process-oriented research

- Calculate recovery rates of sea floor habitat and associated species
- Examine competition between key species
- Examine recruitment variability
- Examine factors affecting growth, reproduction and survival of key species
- Examine life-stage-specific factors affecting habitat use
- Determine residency-time and migration of key species
- Undertake an integrated analysis of food web relationships
- Determine effects of noise on marine mammals
- Develop means to determine extent and nature of animal entanglements
- Determine ecological effects of point-source pollution
- Develop near-real time oceanographic modeling products

Monitoring

- Design and Implement Annual Water Quality Monitoring Plan
- Encourage Placement of Oceanographic Water Quality Monitoring Buoys
- Deploy High Frequency Wave and Current Monitoring Radar System
- Develop and implement vessel noise monitoring plan
- Assess need for vessel speed controls

The above science needs will directly support the following SBNMS management issues:

Implement marine zoning

- Establish a habitat research reference area within the Western Gulf of Maine Closure Area
- Evaluate extending boundaries to encompass additional marine mammal feeding grounds

Strengthen cooperative efforts with other regional resource management agencies and industry

- Coordinate with and support regional efforts to mitigate impacts of gear on marine mammals
- Participate in Regional Resource Management Organizations Involved in Marine Mammal Protection (e.g., Atlantic Right Whale Take Reduction Team)
- Foster Partnerships with Regional Entities Researching Water Quality Conditions
- Implement a whale watching vessel traffic management scheme

Improve Outreach

- Develop Outreach Program for Virtual Sanctuary Visitation (e.g.,Website)
- Develop corporate/celebrity sponsorships
- Develop outreach program for whale watchers including Certification
- Develop regional network of Sanctuary Information Centers
- Establish sanctuary as Regional Marine Education Resource Center
- Develop Volunteer Program to increase effectiveness of public outreach
- Establish "Friends Organization" to leverage capabilities
- Establish Graduate Intern Program with regional universities

6. Current Research at SBNMS

NCCOS proposals funded by ONMS for FY04

A biogeographic characterization of the Stellwagen Bank NMS
CCMA (Tim Battista and Mark Monaco) $90 K

NCCOS proposals funded by ONMS for FY05

A biogeographic characterization of the Stellwagen Bank NMS
CCMA (Tim Battista and Mark Monaco) $80 K

The work proposed here will build upon on-going work being conducted at SBNMS and will extend the SBNMS/NCCOS collaboration being undertaken in FY04. Specifically, in FY04, NCCOS/SBNMS will identify and contact organizations and individuals with spatial/temporal data relevant to (1) physical oceanography, (2) fish distribution, (3) human activity (e.g. commercial fishing and shipping effort), and (4) marine birds, reptiles and mammals. These data will be formatted for GIS analyses and investigated with respect to the spatial/temporal distribution of individual species and assemblages. The deliverables during the first year included a GIS of specified existing GIS coverages in and around SBNMS; a GIS of the 1994-1995 Bird Survey Data; density maps generated from NMFS Vessel Trip Reports; MS Access database with NMFS Trawl data conducted within the SBNMS; and will include a synthesis and mapping of oceanographic data (e.g. temperature, currents, salinity, water masses, stratification).

In FY05, the goal will be to integrate the various data layers developed during the first and second years to initiate a multivariate characterization of the sanctuary. These activities will culminate in a major biological assessment of the SBNMS comparable in intent to the atlas produced by the Biogeographic Program for the central California Marine Sanctuaries (NCCOS 2003). This assessment will allow the SBNMS to monitor changes in, and threats to, the sanctuary and investigate its ability to provide biological refugia. See Schedule section for deliverables and dates.

In addition to the on-going projects being conducted at SBNMS (listed below), the SBNMS/NCCOS collaboration for fiscal years 2003-2005 will be conducted in concert with work being done at SBNMS through a multi-year contract with TPMC/Perot Systems. Specifically, derived products from the development of a large marine database on seafloor habitat impacts from fishing and the distribution of marine mammals will become available for incorporation into the biogeographic assessment. Derived products will include summary data on the distribution of various taxa at the scale of the sanctuary.

Related projects (non-NCCOS) being conducted in a sanctuary

Site Utilization and Movement of Fishes Relative to Landscapes and MPA Boundaries.
Multi-year project directed at quantifying habitat-mediated fish movement behavior using a seafloor-mounted acoustic receiver array. Fishes of a variety of species (e.g., Atlantic cod and Acadian redfish) are being tagged with coded-acoustic pingers. Project begun in 2000 and will continue through 2005. The primary funding is from SBNMS ($50,000 per year) and the primary investigator is James Lindholm

Seafloor Habitat Recovery Monitoring Project
Multi-year project begun in 1998 to quantify the recovery of seafloor habitats and associated taxa following disturbance from natural and anthropogenic sources. Long-term survey sites located within SBNMS inside and outside of the Western Gulf of Maine Closed Area and along the Hibernia fiber optic cable route. Annual cruises conducted with ROVs, video bottom cameras, and side scan sonar. Project begun in 1998 and will continue through 2005. The primary funding is from SBNMS ($300,000 per year) and the primary investigator is James Lindholm

Distribution of Marine Mammals Relative to Human Activities
Multi-year project directed at quantifying the distribution of marine mammals, sea birds and human activities in the sanctuary. Directed sampling (400 meter strip transects) is conducted monthly for 12 months from a research vessel, at three year intervals. Project began in 1994/1995 and conducted again in 2001/2002. The primary funding from SBNMS and the International Wildlife Coalition ($100,000 per year) and the primary investigator is David Wiley

Long-term Patterns in the Distribution of Marine Mammals at SBNMS
Multi-year project involving the assimilation of two 20-year databases on marine mammal sightings in the sanctuary into a single relational database. Data will be analyzed from 1979 to the present in a 1 nautical mile2 grid for multiple species, including humpbacks, right whales, finbacks, and minke whales. Project begun in 2001 and will continue indefinitely. The primary funding is from SBNMS, the Center for Coastal Studies and the Whale Center of New England (approximately $100,000 per year) and the primary investigators are James Lindholm and David Wiley

Distribution of Structure-forming Invertebrates on the Seafloor in SBNMS
Multi-year project involved the mapping of data collected by the National Marine Fisheries Service on infaunal and epifaunal invertebrates in the sanctuary. The recently digitized database includes grab samples and bottom trawls. Project begun in 2003 and will continue through 2004. The primary funding is from NMFS and SBNMS and the primary investigator is John Crawford

Patterns in the diversity of fishes in the Gulf of Maine.
This work evaluates the utility of using common diversity indices to identify diversity hotspots of fishes in the GOM. Comparisons of community at SBNMS with other regions in the Gulf will indicate differences and similarities such that species representation targets can be identified on a spatial basis. The primary funding is from NURC-UCONN and SBNMS and the primary investigator is Peter Auster

Optimization of benthic habitat types for developing alternatives for marine reserves in SBNMS.
A GIS coverage of sediment type has been developed using the USGS multibeam backscatter imagery. MARXAN software will be used to develop a set of alternatives based on a gradient of representation targets for SBNMS. These alternatives may be useful for discussing marine

reserve issues within the context of the management plan revision. The primary funding is from NURC-UCONN and SBNMS and the primary investigators are Peter Auster and Rose Cook.

Additional research being conducted in SBNMS on marine mammals, fish ecology, marine biology, geology and social sciences is highlighted on the web at http://stellwagen.nos.noaa.gov/research/programs.html

Summary of Permits FY03-04

SBNMS Permits- FYO3

Number	Title	Duration	Type	Permittee	Institution
002-04	Habitat-dependent catch composition and food web dynamics with respect to long-term and rolling closures on Stellwagen Bank	1 yr.	Research	Dr. Les Kaufman	Boston Univ.
003-04	Sea Education Association student research	2 yr.	Education	Erik Zettler	Sea Education Assoc.

7. Linking SBNMS Needs with NCCOS Capabilities

The goal of the ONMS/NCCOS partnership is to link NCCOS capabilities to sanctuary management, science and outreach needs. To effectively achieve that goal NCCOS and ONMS must be knowledgeable of the science (i.e., research, monitoring, assessment, technical assistance) activities, capabilities, and resources committed to promoting the success of current collaborations and facilitating future collaborations**.**

The matrix presented in Table 1 illustrates potential collaborations between SBNMS and NCCOS by matching the identified science needs to support sanctuary management with NCCOS science capabilities at each of the Centers. It is apparent that there are numerous areas in which SBNMS science needs could benefit from NCCOS services. Efforts to increase the cooperation between NCCOS and SBNMS should be strongly recommended in order to efficiently leverage limited budgetary resources and maximize benefits for sanctuary management.

Table 1. Potential links between SBNMS science needs and NCCOS science.

SBNMS Science Need	CCMA	CCFHR	CCEHBR	NML	CSCOR
Design and implement a spatially-referenced inventory of habitat types	✓	✓			
Marine mammal data set development and analysis	✓	✓	✓		
Compile existing biological and ecological information of sanctuary biota	✓	✓			
Map distribution of biota by habitat	✓	✓			
Determine spatial and temporal distribution and level of fishing effort/harvest	✓	✓			
Compile tourism profile	✓		✓		

Map human user-group distribution by habitat	✓		✓		
Calculate recovery rates of sea floor habitat and associated species		✓	✓		
Examine competition between key species		✓	✓		
Examine recruitment variability		✓	✓		✓
Examine factors affecting growth, reproduction and survival of key species		✓	✓		✓
Examine life-stage-specific factors affecting habitat use	✓	✓	✓		✓
Determine residency-time and migration of key species		✓	✓		
Integrated analysis of food web relationships		✓	✓	✓	
Determine effects of noise on marine mammals		✓	✓	✓	
Analysis of animal entanglements		✓	✓	✓	
Determine ecological effects of point-source pollution	✓	✓	✓	✓	
Develop near-real time oceanographic modeling products	✓	✓			✓
Design and Implement Annual Water Quality Monitoring Plan	✓		✓		
Oceanographic Water Quality Monitoring Buoys	✓	✓	✓		✓
Deploy High Frequency Wave and Current Monitoring Radar System					✓
Develop and implement vessel noise monitoring plan	✓				
Assess need for vessel speed controls	✓	✓			

8. Contacts

NCCOS

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Additional useful links for potential NCCOS investigators:

SBNMS publications http://stellwagen.nos.noaa.gov/about/staffpapers.html
SBNMS bibliographie http://stellwagen.nos.noaa.gov/about/bib_intro.html
Gulf of Maine Ocean Observing System http://www.gomoos.org/